BROOKHAVEN NATIONAL LABORATORY

Superconducting Magnet Division

sPhenix Babar Magnet FY15 SMD Activities

December 16, 2014

M. Anerella

Present Magnet Status

- SC Solenoid Magnet is at SLAC
  - BNL heat shield shipping restraints are fabricated & received at SLAC
  - SLAC has:
    - Installed BNL restraints
    - Tightened coil supports
  - SLAC will:
    - Rig magnet onto truck
- Valve box is at SLAC
  - BNL shipping restraints have been fabricated & installed
  - Valve box will ship separately from magnet
- Other ancillary equipment is crated, will also ship with valve box

FY15 SMD Scope

- Safely transport Babar magnet to BNL (January)
- Engineer / fabricate Valve box mods for sPhenix (P. Kovach talk)
- Assemble / prepare magnet on arrival
  - Remove shipping restraints
  - Perform incoming inspection & tests (more later)
  - Pre-tension/Adjust coil supports / align cold mass
- Install valve box extension & valve box (when available)
- Perform final inspection & tests
- Oversee low power testing

Incoming inspections & tests

300K Coil Electrical Testing:

- R, L and Q
- Impulse test
- 520V Hypot
- Instrumentation inspections; voltage taps, strain gauges, etc.

Mechanical Inspections:

- Visual (damage or other shipping incidents)
- Helium circuit vacuum leak check
- Cryostat vacuum leak check

Coil position alignment (by re-tightening tie rods by prescribed amounts)

Valve Box Assembly & Testing Preparations

- Upon arrival at BNL:
  - Final valve box design & drawing release
    - Work complete by 1 Feb 2015
- Fabrication of valve box, extension parts by 1 Apr 2015 (requires early release of work as possible)
- Installation of valve box, extension by 1 May 2015 (requires support platform by C/AD)

Ready for (912) cold test May 2015

Final inspections & tests

300K and 4K Coil Electrical Testing:

- R, L and Q
- Impulse test
- 520V Hypot

Mechanical Inspections:

- 300K and 4K Helium circuit vacuum leak check
- 300K and 4K Cryostat vacuum leak check

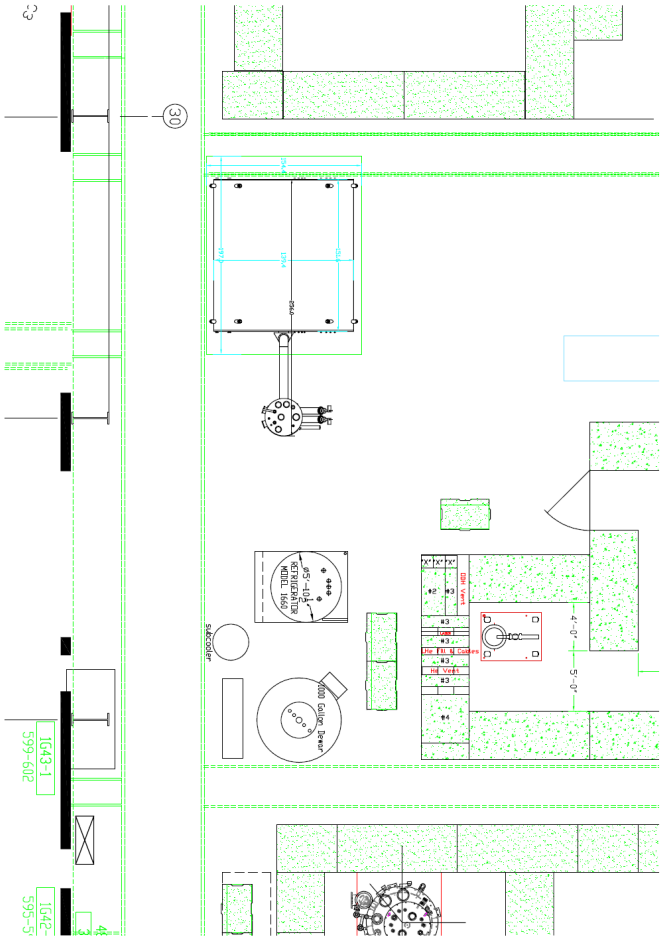
BROOKHAVEN NATIONAL LABORATORY

Superconducting Magnet Division

FY15 Low Power Cold Test

From Dave Phillips

Bldg. 912 test location



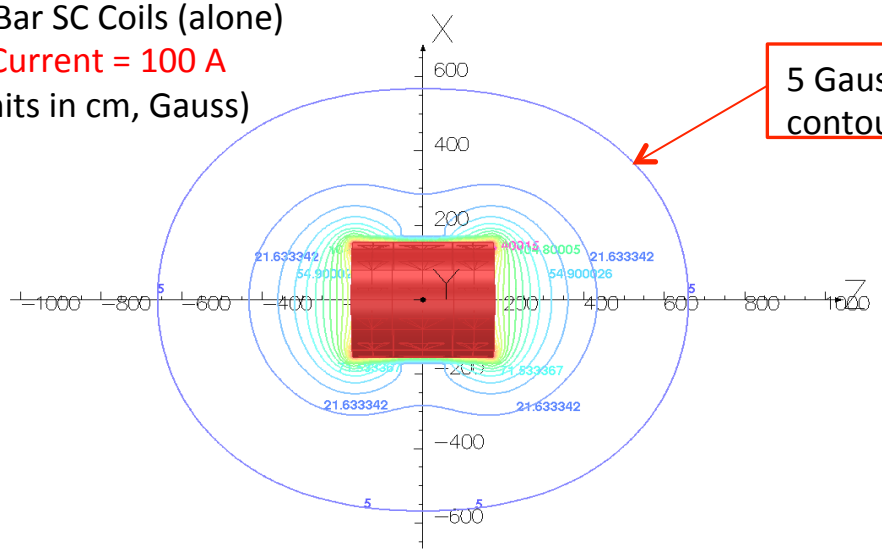
- Power supply (from Ioannis Marneris) = 500A, 30V; 0.1 Ω resistor in series.
- C-AD also to provide free wheel diode.
- Data Acquisition System from SMD

From Wuzheng Meng

BaBar SC Coils (alone)

Current = 100 A

(units in cm, Gauss)



M. Anerella

Low Power Cold Test Plan p.1

From Joseph F Muratore
11-Dec-2104

sPHENIX Solenoid Magnet Cold Test Plan Summary

A. Electrical Checkout at Room Temperature

1. Measure lead resistances to ground with meter
2. DC series voltage tap resistance measurements at 1 A
3. Impulse test of full coil
4. Hipot to ground of magnet leads
5. Validate stop signal
   a. Half Coil Difference (Delta)– inner and outer layer voltage difference; balance for different inner and outer inductances
   b. Current Derivative (I_{dot})– using total coil voltage and inductance
6. Vacuum leak check of cryostat

Low Power Cold Test Plan p.2

B. Cooldown to 4.5 K (~ 10 days - See SLAC plot; shorter w/LN2 precool, see P. Orfin talk)

C. Electrical Checkout at 4.5 K

1. Measure lead resistances to ground with meter
2. AC voltage measurements at 1 A
3. Impulse test of separate layers and full coil
4. Hipot to ground of magnet leads
5. Ramp to 50 A at 1 A/s. Measure inductance and determine voltage threshold.

   Adjust lead flow if necessary.

   Fast data 1 kHz sampling rate.

Low Power Cold Test Plan p.3

D. Ramp Testing

Fast data at 1 KHz. Slow logger at 1 s. 1 A/s ramp rate.

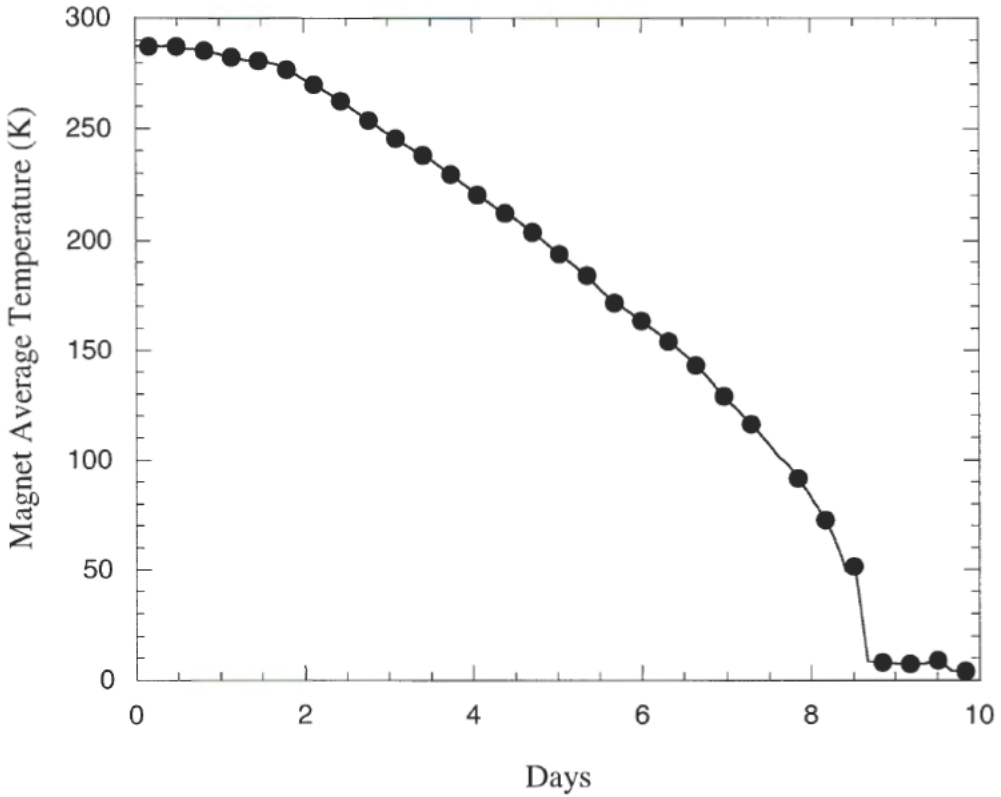
1. Ramp to 100 A. Verify inductances. Monitor leads and adjust flow if necessary.
2. 5 power cycles from 0 A to 100 A at 1 A/s. 1 kHz sampling rate.
3. 1 hour at 100 A. Monitor leads and coil voltages. Slow logger at 1 s sampling rate.
4. If no quench occurs, warm up magnet to room temperature.
5. If quench occurs, analyze voltage tap signals to determine cause. If signals show no anomalies, repeat ramp test to 100 A.

Back-up slides

SLAC magnet cool down data

May 12, 1998 – Rev 4

COOL-DOWN



Cautions

- Magnet has a cold leak (nearly impossible to find (or therefore fix, so one simply hopes it doesn't worsen). From "BABAR Superconducting Solenoid Acceptance After Final Test at SLAC"

  "When cold it was observed that after closing the cryostat vacuum isolation valve the pressure increased from - 1.5 1 o-7 to 2 1 o-5 mbar in 18 h. This equates to a He leak of - 2 1 o-6 mbar 1 /s . This leak when cold is compatible with a 300 K leak of 1 10-8 mbar 1/s. Unfortunately, the leak requires that the cryostat be pumped constantly."

(parenthetic thought – perhaps we are fortunate that the valve box is removed. If desired, a test assembly can be designed and built to cool down the valve box independently and test to determine if the cold leak is in the magnet or valve box)

- From Dr. Pasquale Fabbricatore,

  "Only the chief technician, remembered that he dismounted the flanges and put blocks keeping the cold mass solidly anchored to the cryostat. The photos I found later confirmed that. Unfortunately, even if the magnet construction engineering is fully documented in detail, the transportation engineering is strangely missed. In particular I did not find any drawing of the transportation blocks."

Dedicated shipping frame in use last time

- No shock or vibration isolation between magnet and truck
  →Air ride trailer needed

Excerpt from SLAC lifting procedure

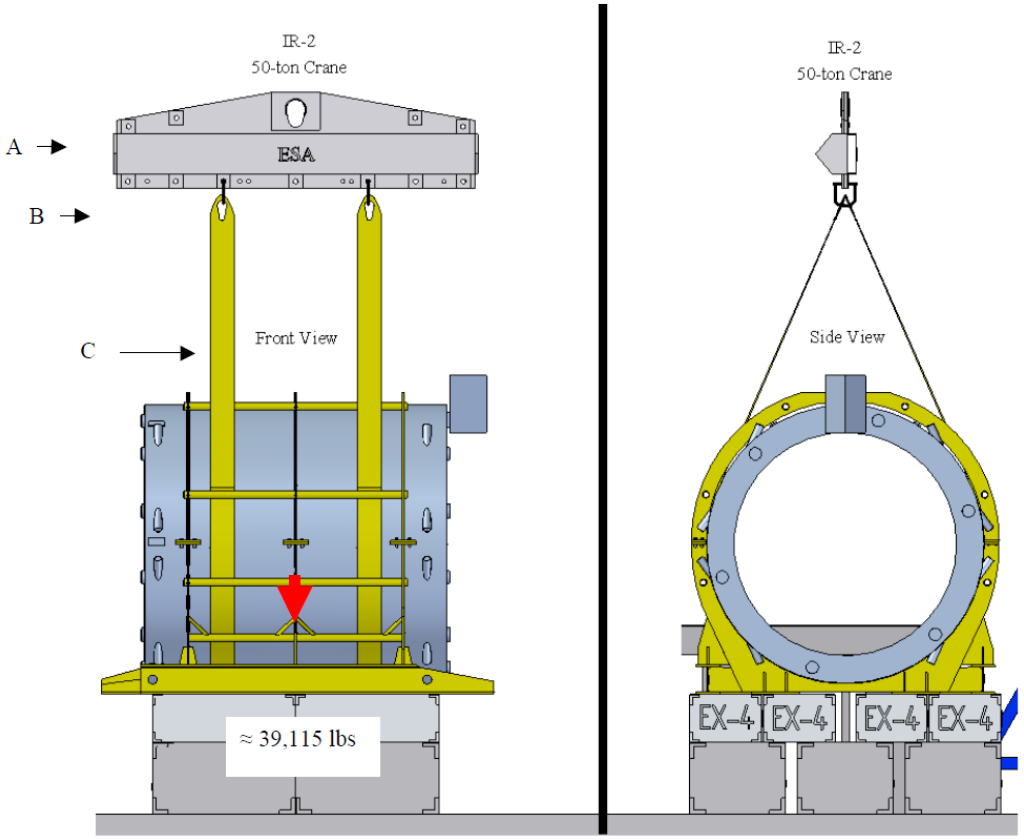


Figure 52: Attach Two 50' Wide-Body Slings around the Superconducting Solenoid & to the ESA Spreader Bar

- Magnet is at SLAC
- Valve box has been disassembled and removed; not usable for sPhenix, but perhaps parts (vapor cooled leads, etc.) can be salvaged
- Shipping frame (shown in yellow) is available but not installed?
- No internal shipping restraints are installed or available; no engineering information has been provided
- Spreader bar is useful if available

From "BABAR Superconducting Solenoid Testing and Acceptance Procedure"

October 16, 1997 Rev 7

Appendix A

Solenoid Installation at SLAC

1. Solenoid arrives at SLAC
2. Unpack solenoid in IR2: Remove the plastic cover. Loosen the transportation rings around the solenoid. Rotate the solenoid 135 degrees using rigging straps. Wrap the straps around the solenoid and pull on the straps slightly off center, rotating the solenoid a few degrees at a time.
3. Remove axial blocks: Remove the axial constraints used to block the thermal shields and coil.
4. Check radial location of coil: Using a tool designed and fabricated by SLAC in the 3 ports at each end of the cryostat used to block the thermal shield and coil.
5. Install the axial positioners: Install the SLAC designed and fabricated axial positioners used to mechanically determine the axial location during cool down and solenoid powering.
6. Global leak test the cryostat: Check if the winding cylinder cooling circuit and the thermal shield are leak tight. While pumping on the cryostat, pressurize the cryogenic pipings to 1.25 times the design pressure and check for leaks using a helium mass spectrometer. The helium mass spectrometer must be calibrated to be able to detect a leak rate of $< 10^{-9}$ mbar l s^{-1}.

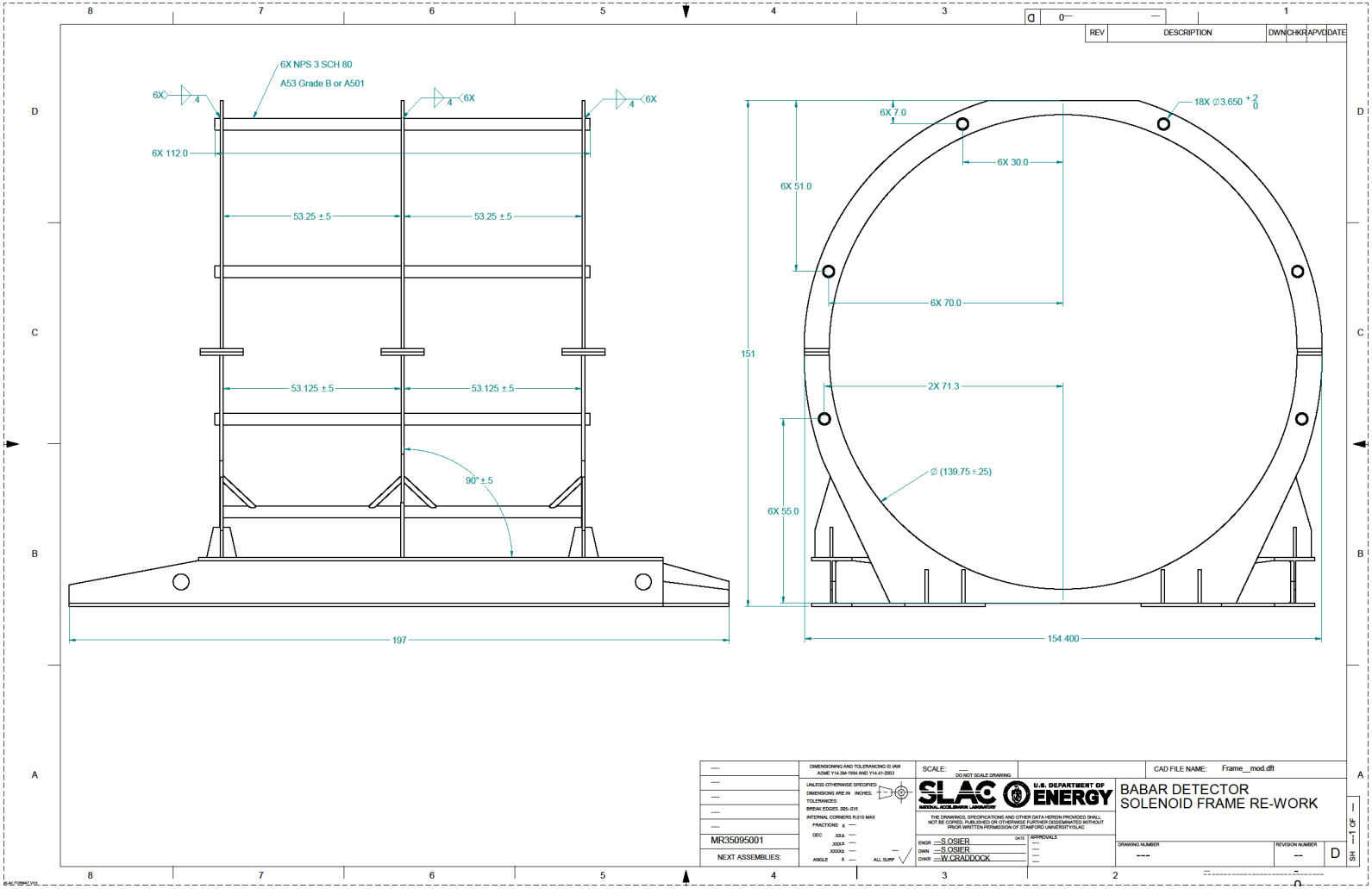
Confirmation that shipping restraints were employed

Superconducting Magnet Division

Superconducting Magnet Division

BROOKHAVEN NATIONAL LABORATORY

Superconducting
Magnet Division



M. Anerella